

Micrometeorite Impact Test of Flex Solar Array Coupon

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Background

- ❑ SSL is developing an advance, lightweight, flexible 28kW solar array for commercial use
 - Based on Deployable Space Systems (DSS) Rollout Solar Array (ROSA) designs
 - Power level comparable to present SSL rigid solar array design
- ❑ Design risk reduction efforts are underway
 - Mechanical evaluation at DSS
 - Thruster plume evaluation at the NASA/JPL
 - Thermal cycle evaluation at the Air Force/AEDC
 - Thermal balance evaluation at the NASA/GRC
 - Micro-meteoroid impact evaluation at the NASA/MSFC

Test Coupon

- ☐ Solar cell: SolAero ZTJ at 59.7 cm² area
- ☐ Coverglass: Qioptiq, 100-μm thick, single-layer of MgF₂
- ☐ Substrate: 50 micron thick Kapton sheet
- ☐ 3 strings w/2cells per string
- ☐ Strings are NOT grouted with RTV adhesive

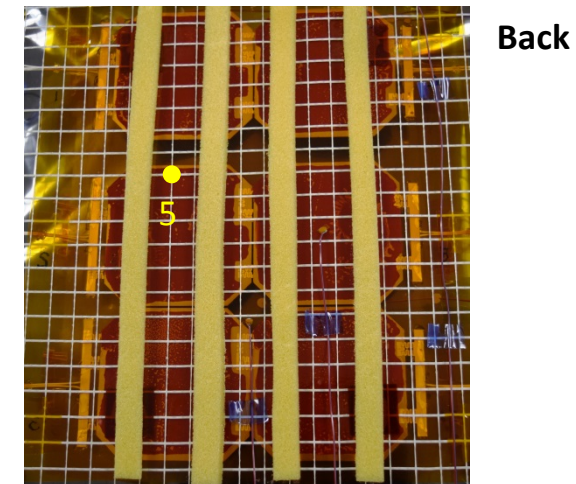
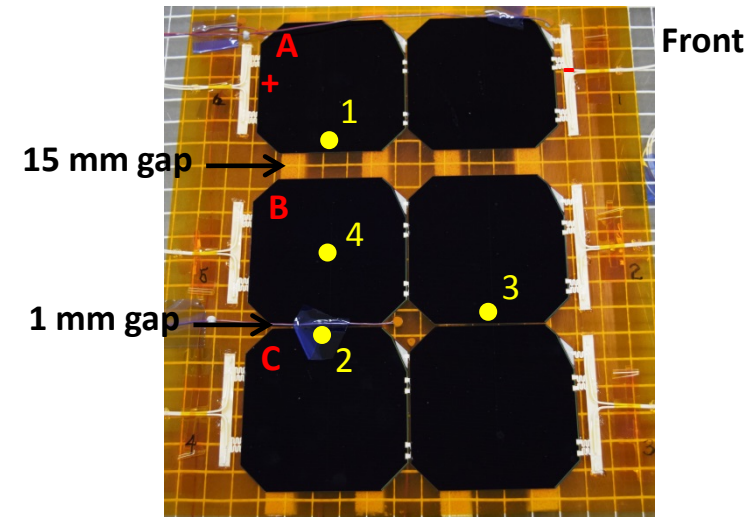
Electrical Configuration

Test Shot	Impact Side	SAS Volt./Cur.	String A	String B	String C
1	Front	100V/1.1A	High	Low	NP
2	Front	15V/1.1A	NP	Low	High
3	Front	22.5V/1.65A	NP	Low	High
4	Front	150V/1.65A	High	Low	NP
5	Back	150V/1.65A	High	Low	NP

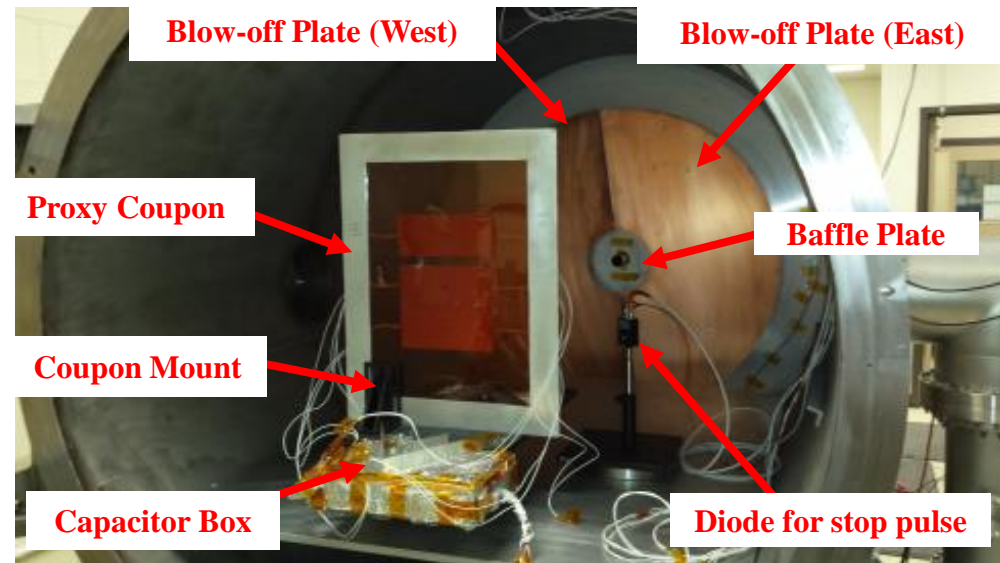
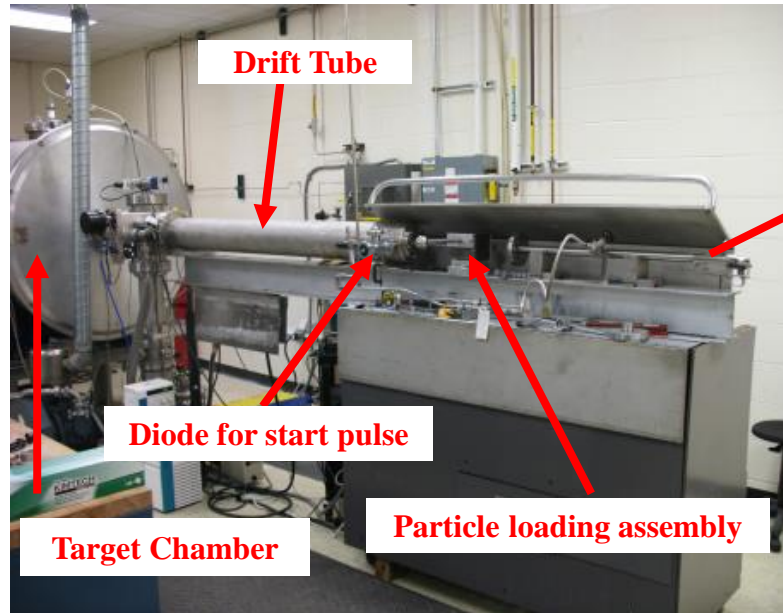
High = Solar Array Simulator (SAS) voltage

Low = SAS return

NP = Not Powered

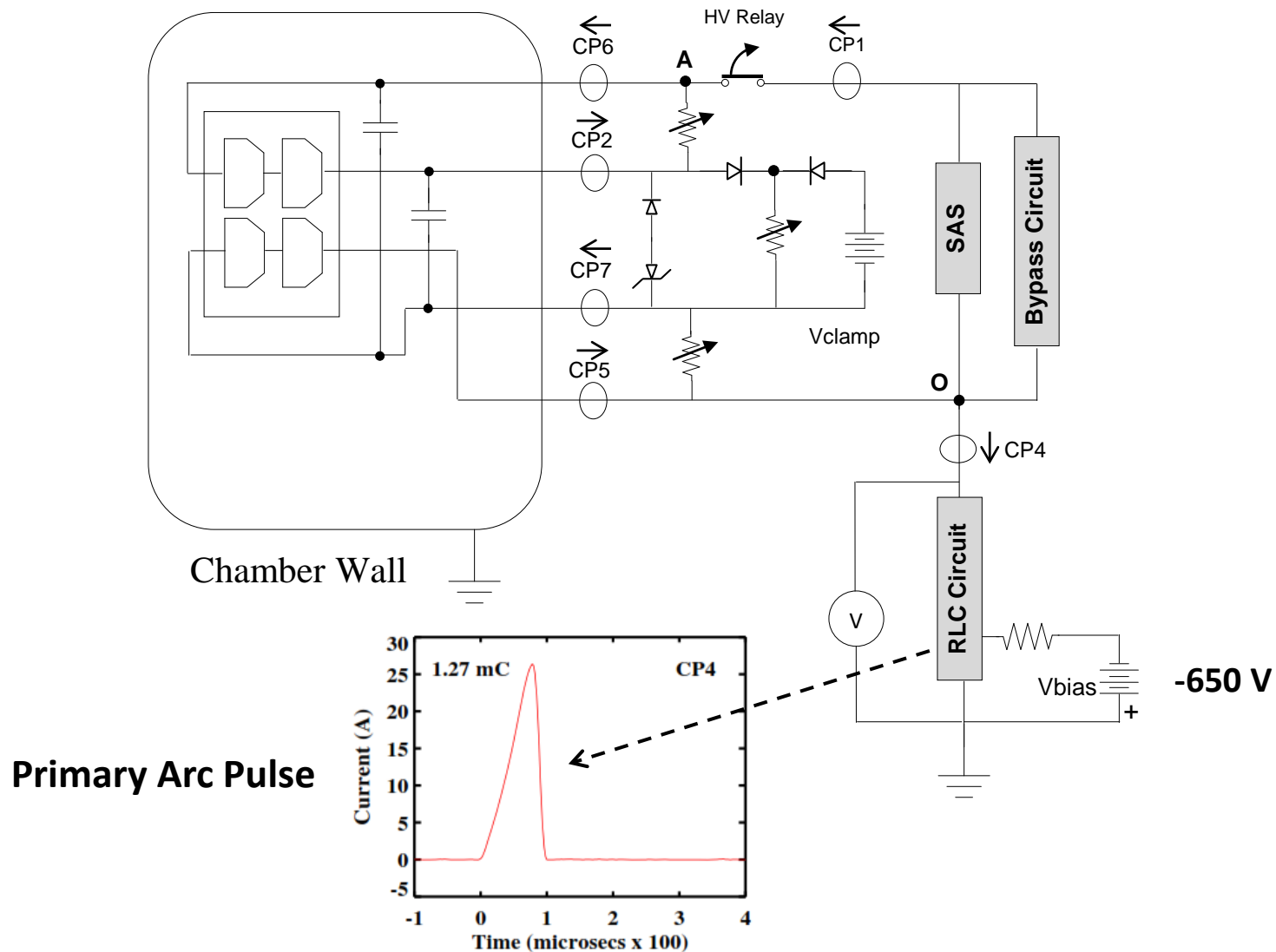


NASA/MSFC Micro Light Gas Gun (MLGG)



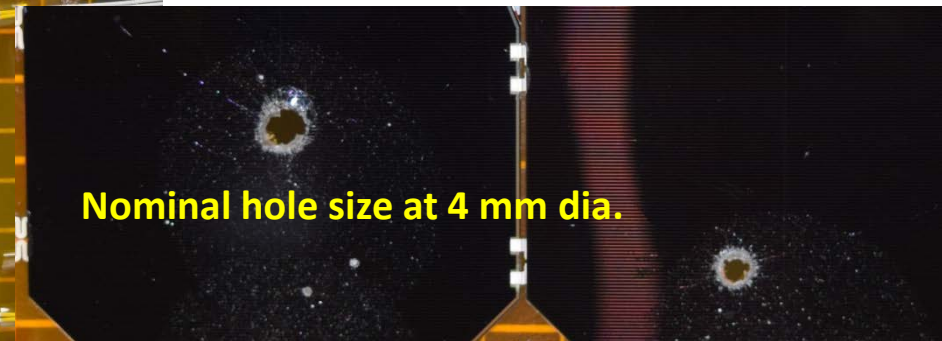
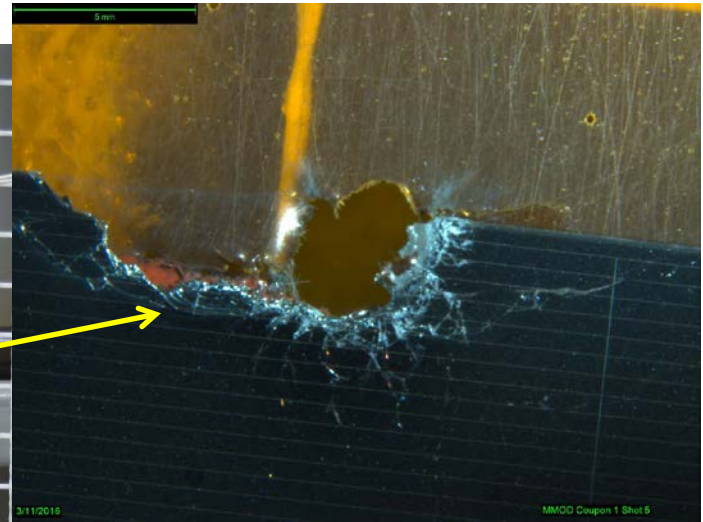
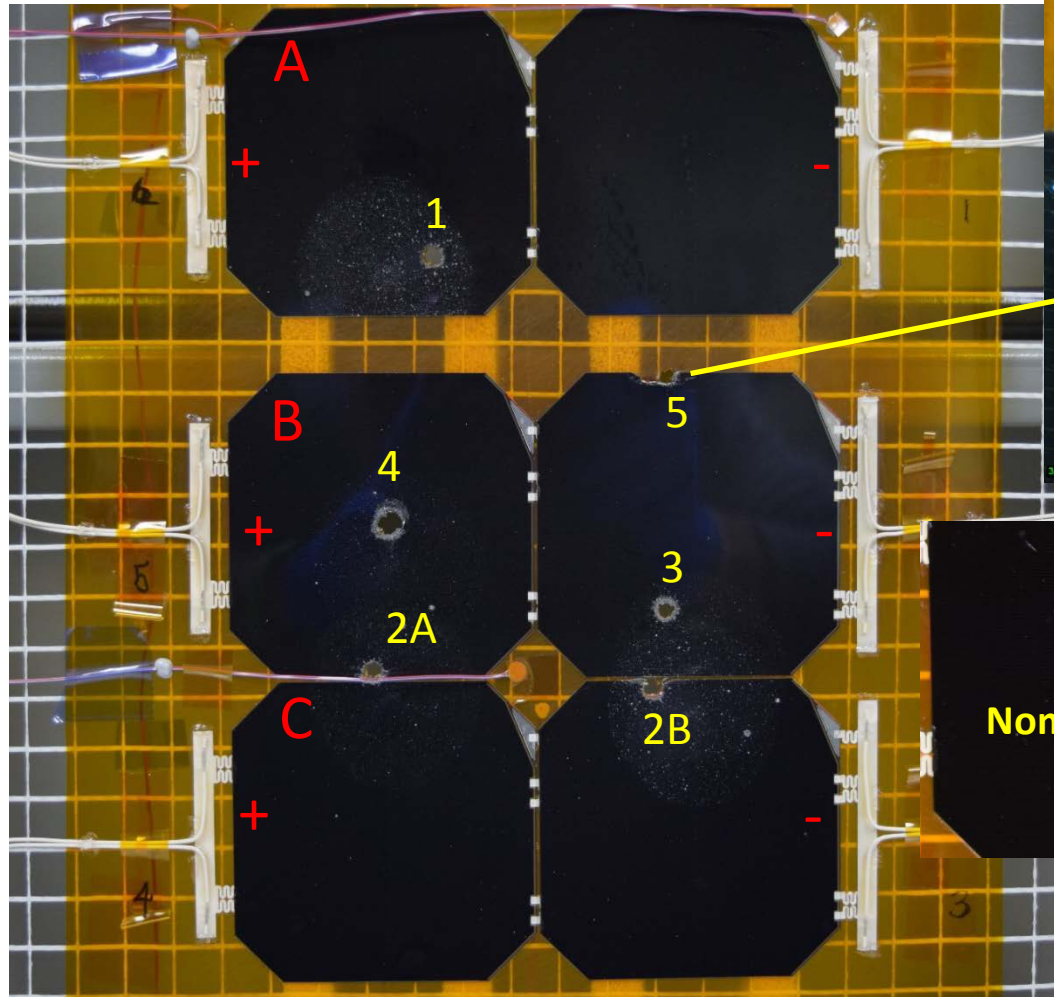
- A Nylon pellet (1.76 mm dia. by 1.76 mm length) is used as the debris proxy and reaches speeds $> 5\text{km/s}$

Electrostatic Discharge (ESD) Test Circuit



Impact Results

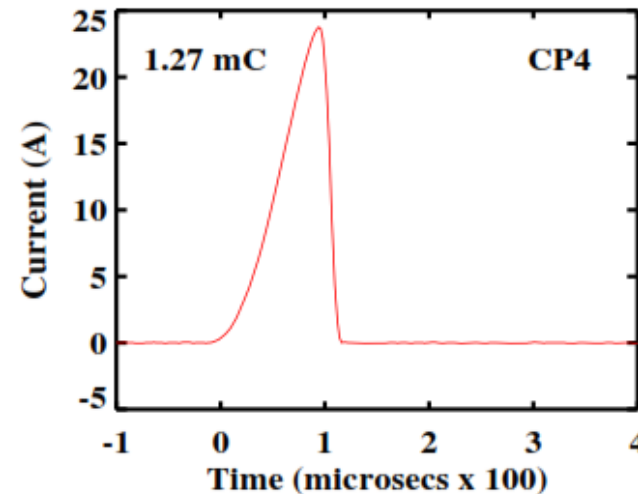
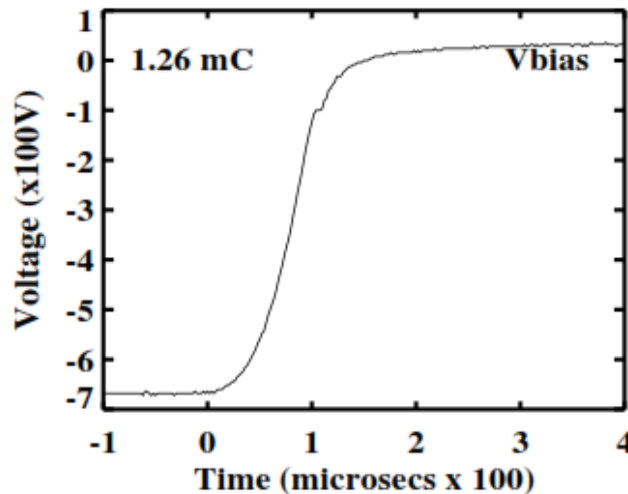
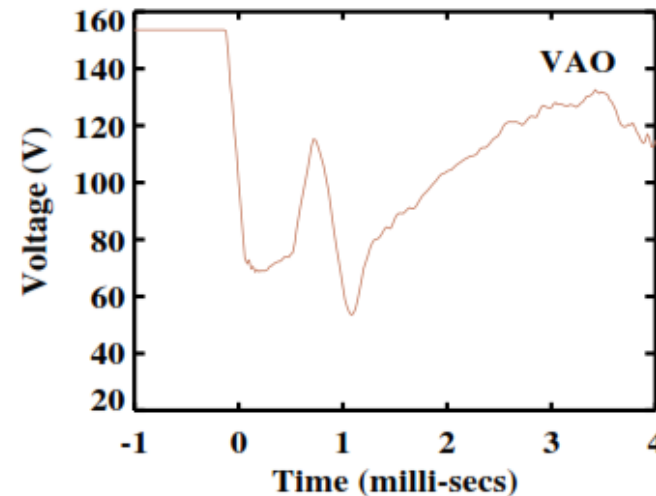
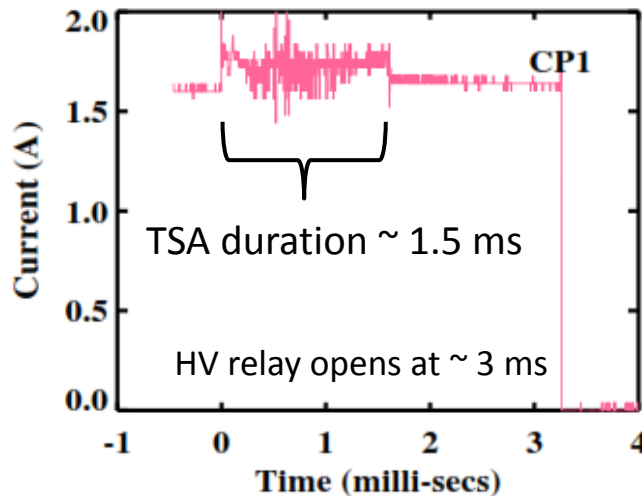
Front View



Impact 5: Temporary Sustained Arc (TSA) event

Coupon-1: Impact 5 (B back); String-A-to-B at 150V; SAS at 1.65A

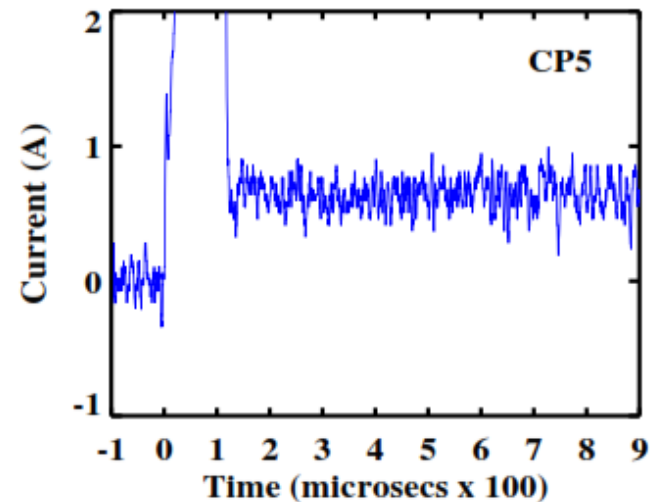
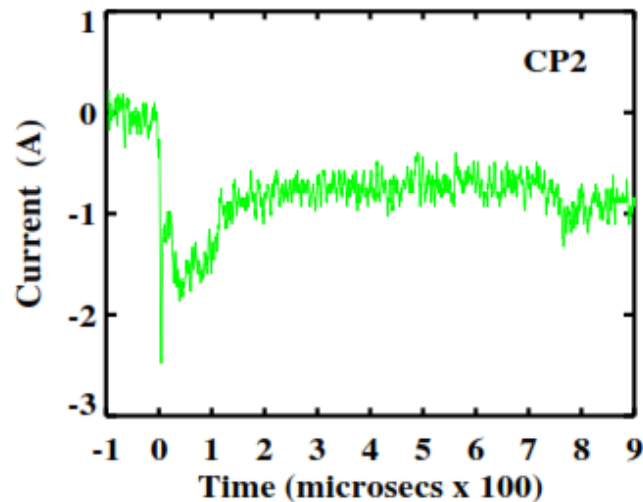
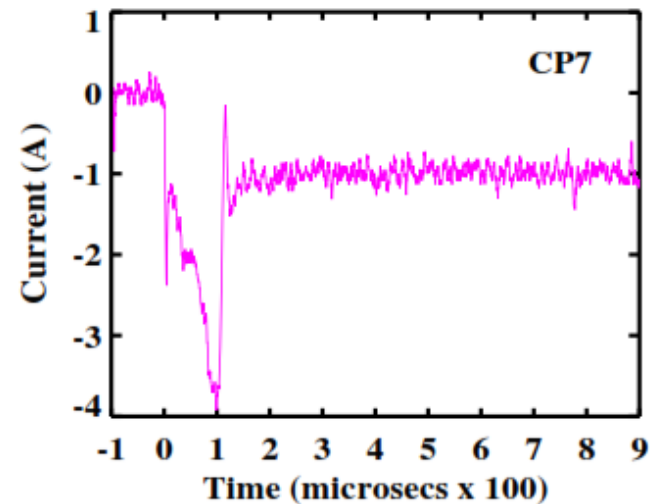
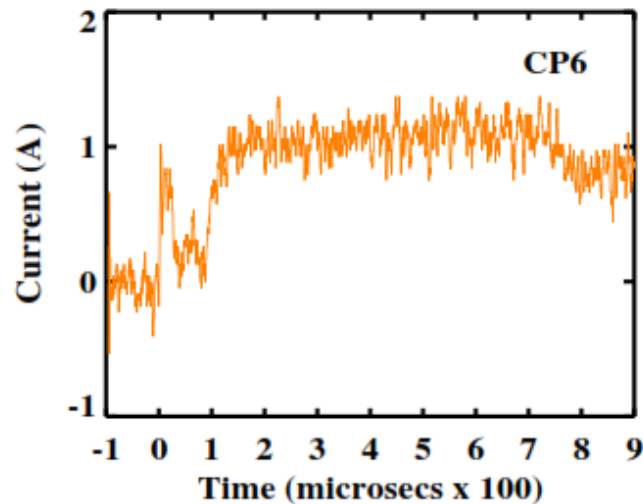
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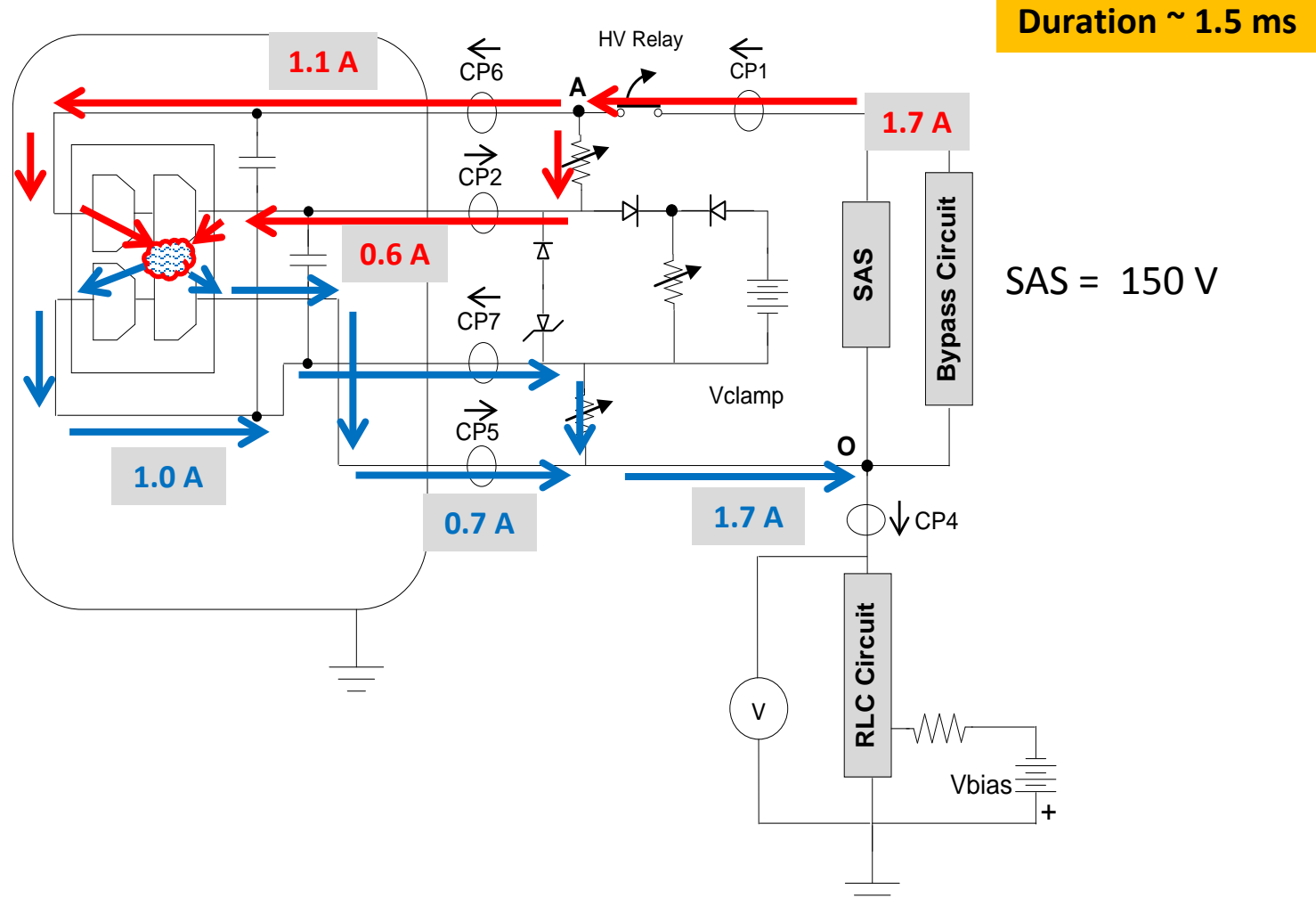
Impact 5: TSA event

Coupon-1: Impact-5 (B back); String-A-to-B at 150V; SAS at 1.65A

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Impact 5: Estimated TSA Current Paths



Summary

- ❑ NASA/MSFC has performed impact testing on SSL ROSA coupons
- ❑ No Permanent Sustained Arc (PSA) observed for any of the six impacts
 - However, further impact testing may be needed to clarify the results and to demonstrate the ROSA design robustness
- ❑ Post-impact observations
 - Local damage only – no structural breakdown
 - No visual evidence of arc tracking on Kapton or pyrolyzation
 - Insulation resistance measurement after impacts same as Beginning-of-Life; namely, $> 50 \text{ G}\Omega$ between all string combinations